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THE CLOVER LEAFHOPPER[1] AND ITS CONTROL IN THE CENTRAL STATES.

By EDMUND H. GIBSON,

Scientific Assistant, Cereal and Forage Insect Investigations.

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INTRODUCTION.

The control of the injurious clover leafhopper (fig. 1) is a comparatively simple task to one acquainted with the habits of the insect.

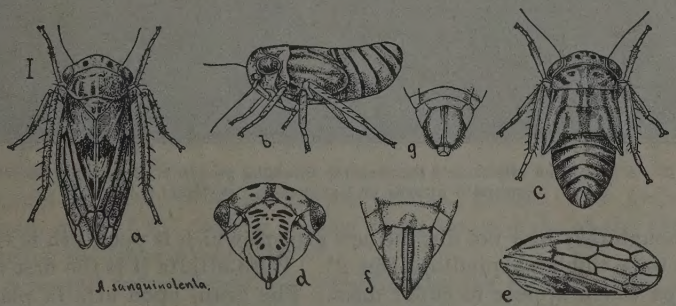

FIG. 1.—The clover leafhopper (*Agallia sanguinolenta*): *a*, Adult; *b*, nymph, side view; *c*, nymph, dorsal view; *d*, face; *e*, elytron; *f*, female genitalia; *g*, male genitalia. All enlarged. (After Osborn and Ball.)

The injuries caused by this insect, as is the case with many other leafhoppers, are often overlooked because of the minute size of the pest, and the apparent injury is too frequently attributed to such causes as poor soil and climatic conditions.

[1] *Agallia sanguinolenta* Prov.; suborder Homoptera, family Bythoscopidae.

NOTE.—It is the purpose of this bulletin to set forth such facts as will familiarize the farmer with the various stages in the development of the clover leafhopper, its habits, and mode of attack, together with detailed information as to the control of outbreaks in alfalfa and clover fields.

IMPORTANCE OF THE DAMAGE.

Each year this leafhopper, by lessening the vitality of its food plants, occasions more or less damage over its entire range of distribution, causing a positive, although not easily estimated, decrease in the clover and alfalfa hay crops of the country. Continued attacks often result in the loss of a considerable percentage of a single cutting; especially is this true in some of the central States. The leafhopper causes the greatest damage during the spring and early summer months, as the foliage is then most succulent and the tissues very tender, enabling even the immature leafhoppers readily to pierce the skin of leaf and stem and suck the juices. The incessant drain from concentrated attacks causes the clover plants to wither, and

FIG. 2.—A spot in an alfalfa field showing the spindling growth of the plants, caused by continued attacks of leafhoppers. (Original.)

although they may not die, the new growth which is put forth is very apt to be thin and spindling (fig. 2). With alfalfa it is the first two crops which appear to suffer most. The drain upon alfalfa plants does not show as markedly as with clover, especially during a drought, since the alfalfa roots go deeper into the ground and the plant is better able to withstand adverse conditions.

DESCRIPTION OF THE INSECT CAUSING THE DAMAGE.

In many localities these leafhoppers are commonly known as "flies," but in reality they resemble flies only in having wings, and because they are about the size of many small flies seen in the fields. The adult or parent insects (fig. 1, *a*) are light gray in color, but have numerous dark markings which give them a mottled appearance. They are about one-eighth of an inch in length and half as wide.

The face (fig. 1, *d*) is triangular and is marked with short black lines. The two small, round, dark spots on the upper side of the head distinguish the clover leafhopper from many others frequently observed in alfalfa and clover fields. The nymphs, or young, resemble the adults in form but lack wings. In color they are creamy white with heavy dark spots and bands. The eggs are white and very small. To the farmer, leafhoppers will be distinguished from other insects not so much by their form and markings as by their habit of jumping, their quick movements, and their minute size. The manner in which they jump from plant to plant is much like that of grasshoppers.

WHERE THE LEAFHOPPER OCCURS.

The clover leafhopper is distributed generally throughout the United States, records showing its occurrence in every section of the country. Its range also includes southern Canada and Mexico.

THE INJURY, AND HOW IT IS PRODUCED.

The primary injury is produced by the direct feeding of the leafhoppers. The single tiny feeding puncture is itself inconsequential, and injury results only when a great number of leafhoppers attack the same plant. As many as 600 have been counted upon one plant. The early stages of injury are indicated by a yellowing of the tissue around the feeding punctures. These spots gradually enlarge and become more pronounced, and the plants take on a sickly condition which results in the curling up of the leaflets and the final wilting of the foliage. The leafhoppers have been noted to puncture the flower buds and petals, and in this way to cause a decrease in the amount of seed produced. Upon grains, grasses, and grasslike plants most of the feeding is done along the midribs of the blades, causing the latter to shrivel.

A second form of injury is produced by the forcing of the eggs into the stem and leaf tissue by the adult female. This causes a distortion of the surrounding tissue and often results in a gall-like formation.

PLANTS ATTACKED.

The principal plants attacked are those of the bean family, including alfalfa, clover, cowpea, and vetch; although the species is common in meadow and pasture lands and feeds on a number of cultivated as well as native grasses. Adults have been captured in wheat, rye, and barley fields, but in all probability they migrated there from near-by grasslands or clover fields. The frequent occurrence of this leafhopper in wheat in the eastern half of the United States

is very probably due to the practice of planting wheat before the clover comes up in the spring. In some of the western States it has at times been considered a pest to sugar-beet plants.

As plants of one family constitute the principal food plants of this leafhopper, it is to be assumed that it has not the power of readily adapting itself to changes of food plants. The fact that the clover leafhopper occurs in grass and pasture lands and also feeds upon grain plants in the absence of clover or alfalfa during the winter and spring merely indicates that when its favorite plants are not obtainable it is forced to seek food elsewhere.

STAGES AND LIFE CYCLE OF THE LEAFHOPPER.

There are three general stages in the development and growth of all leafhoppers, namely, egg, nymph or immature stage, and adult. The adult female places her eggs in stems and leaves, these hatching in from 5 to 12 days during the summer months in the latitude of southern Illinois. The nymphs develop and increase in size by shedding their skins through a series of five molts, becoming adults after the last molt. The nymphal stage in the same latitude ranges from 18 to 35 days, with an average of 25 days.

NUMBER OF GENERATIONS IN A YEAR.

The number of generations of the leafhopper produced annually in a given locality varies from year to year, depending on weather conditions, and it also varies in different latitudes and climates. For southern Missouri and northern Arkansas there are usually three distinct broods, covering approximately (1) April and May, (2) June and July, and (3) August and September. Farther south or under subtropical conditions it is probable that there are four or more.

HOW THE LEAFHOPPER PASSES THE WINTER.

In the Northern States the clover leafhopper hibernates in the adult stage, at the base of clumps of grass and weeds and under dried leaves and trash. Throughout the Central and Southern States it could hardly be said to hibernate; instead, the adults merely keep in hiding and under cover during cold weather, coming out on warm days to bask in the sun and feed upon such green foliage as can be found. In Missouri, for example, the adult insects have been observed feeding upon wheat during January and February, but not in any abundance. Nymphs can not long survive cold weather, and it is not probable that eggs survive over winter. In the extreme Southwest, where conditions are radically different, the leafhopper is active throughout the entire year.

HABITS OF THE ADULT AND YOUNG LEAFHOPPERS.

The adults are quick of movement and jump from plant to plant when disturbed. When strong winds prevail they remain in hiding, as they seem to dislike windy weather. Their most characteristic habit is that of congregating in great numbers on one plant, frequently to such an extent that they crowd one another. This is what causes the concentrated attacks in "spots" throughout a field. The clover leafhopper does not seem to seek shady or damp places, rather preferring the heat of the midday sun.

The nymphs are much less active than the adults and are not easily disturbed. When one brushes against the plants they cling fast to the stems and leaves instead of jumping to another plant. Like the adults, they have the habit of crowding together along a stem or upon a leaf.

ENEMIES OF THE LEAFHOPPER.

The insect enemies of the clover leafhopper seem to be few. Birds appear to be the most important enemies, and among the common species known to eat various species of leafhoppers in numbers are the nuthatches, yellow warbler, blue-headed vireo, long-billed marsh wren, nighthawk, phoebe, tree swallow, cliff swallow, bank swallow, and chickadee. In addition to these, over a hundred species of wild birds are known to feed upon leafhoppers. These birds should receive protection at the hands of the farmer. Chickens, turkeys, and guinea fowl, when allowed to run in the clover and alfalfa fields, eat great numbers of both nymphs and adults. Many adults have been observed in spider webs, and it is very likely that in their jumping from plant to plant numbers are caught in the webs.

CONTROL OF THE LEAFHOPPER.

BURNING OF RUBBISH AND WASTE VEGETATION.

The burning of rubbish and vegetation during the winter months in waste places such as on ditch banks, on terraces used in certain sections for the prevention of erosion, and along fence rows and roadsides will do much to prevent the species from becoming destructive the following spring and summer, for if this is done, their winter quarters will be destroyed and great numbers of the leafhoppers, as well as many other hibernating insects, will be killed.

CLOSE CUTTING OR PASTURING OF GRASSLANDS; EARLY CUTTING OF ALFALFA.

Close cutting or pasturing of grasslands is recommended while the leafhopper is in the adult stage. Cutting the alfalfa crop from a week to ten days earlier than usual will often have the desired effect of checking the species, and is advised where there is evidence that the leafhoppers are causing sufficient injury to justify the risk of damage through premature cutting.

USE OF THE HOPPERDOZER.

For direct control the hopperdozer is recommended. Any hopperdozer which has been constructed to capture grasshoppers will suffice, but a much lighter and less expensive one can be made by stretching canvas over a light wooden frame. The diagram, figure 3, shows how it can be made. It is of such light weight that in pulling it over alfalfa and clover the plants are not injured. In pulling this hopperdozer through fields which are free from stones runners will not be necessary. It is drawn by two horses, one hitched at either end of the two-by-four, and is dragged over the crop, covering as much acreage in the same length of time as is gone over by a cutting or mowing machine. Figures 4 and 5 show the front and back of the hopperdozer ready to be drawn through an alfalfa field. It is to

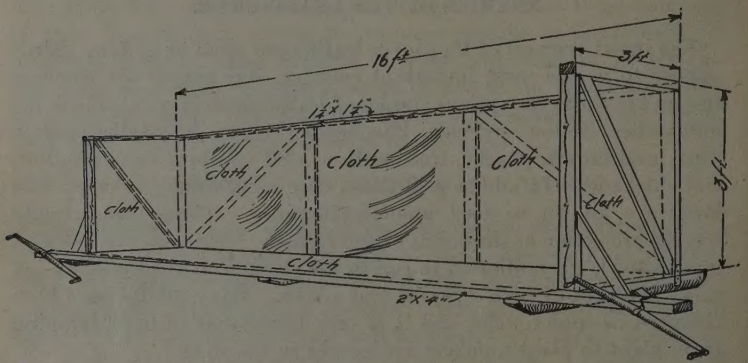

FIG. 3.—Construction of frame of hopperdozer for destruction of leafhoppers, over which canvas is stretched. (Original.)

be regretted that in figure 4 the bottom of the hopperdozer is not visible. Heavy canvas is stretched and tacked or nailed over the inside of the frame, covering bottom, back, and sides.

Over the canvas, on the inside, is applied a thin coat of a sticky substance made of tree tanglefoot which has been thinned with a cheap commercial grade of castor oil at the rate of 1 pound of tanglefoot to one-fourth pint of castor oil. This can be spread on the canvas with a paddle or shingle. The leafhoppers and other insects alighting on the sticky surface are held fast. These insects, together with dried leaves which will adhere to the canvas, can be scraped off whenever necessary and another coating of tanglefoot applied. One coating should be sufficient for 5 acres.

The cost of the hopperdozer should be little more than the price of the canvas, as odd pieces of lumber can be used in construction.

Tree tanglefoot can be obtained in 10-pound cans at $1.65 per can, and the castor oil at a maximum cost of 30 cents per quart. With-

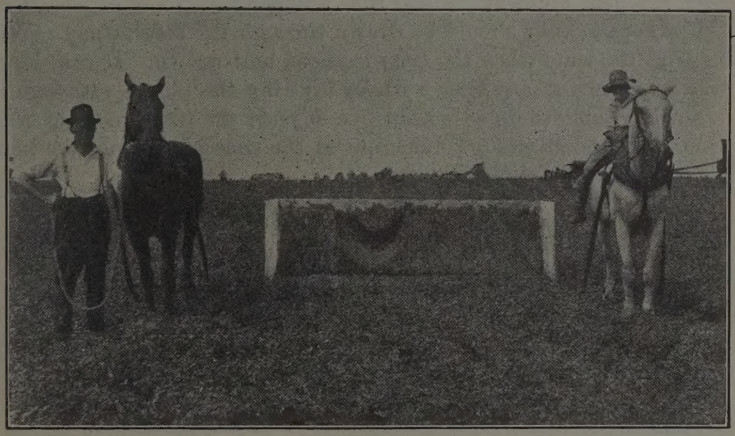

FIG. 4.—Front view of hopperdozer for destruction of leafhoppers as it is being drawn through an alfalfa field. (Original.)

out considering labor, the cost of this control measure should not be more than $4 for 100 acres, or at the rate of 4 cents per acre.

FIG. 5.—Side and back view of the hopperdozer for destruction of leafhoppers. The horses are hitched to the projecting ends of the two-by-four. (Original.)

This method is practical in fields covering several hundred acres as well as in small fields. Other sticky substances such as cheap sor-

ghum and corn sirup have been tried in place of tree tanglefoot but with much less success, as they dry out too quickly; this necessitates more frequent applications and thus renders them more expensive.

The hopperdozer should be drawn through the alfalfa and clover fields at the time when the crop is about half grown. It can, however, be drawn at any time without injuring the plants, although it is not advisable to do so within five days of the time the crop is to be cut. If the adults are numerous at the time of cutting, the hopperdozer should follow the rake.